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RESEARCH

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Which STEM careers are most appealing? Examining high school students' preferences and motivational beliefs for different STEM career choices

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Abstract

Background Decades of research have examined what motivates students to pursue careers in science, technology, engineering, and mathematics (STEM) fields, but STEM careers are a broad category encompassing hundreds of distinct vocations. The present study examined high school students' relative preferences for pursuing some types of STEM careers over others and explored what motivational beliefs (defined in accordance with situated expectancy value theory) most influenced students' relative career preferences. A secondary goal was to examine whether there were differences in any patterns as a function of students' intersecting gender and racial/ethnic identities. A large sample of high school students ($N = 526$) completed an online survey during class time about their beliefs regarding fifteen different STEM career categories.

Results Students' career preferences could be classified into four groups: appealing, unappealing, polarizing, or overlooked. The last category was the most common. Students primarily selected reasons related to utility and attainment value in influencing their choices of most- and least-preferred careers. However, within this category, beliefs about helping others were stronger influences on choosing most-preferred careers, whereas concerns about fitting in were more influential for choosing least-preferred careers. Gender and racial/ethnic comparisons suggest differentiation in how students think about the appeal of various career paths as early as high school.

Implications Findings shed light on how students come to perceive some STEM career paths as relatively more appealing than others, with attention to gender and racial/ethnic differences in these processes. Findings also point to specific and actionable ideas for how teachers, counselors, and administrators can target career education to cultivate students' interest in STEM career paths, where there are particular needs.

Keywords STEM education, Vocational education, STEM careers, Expectancy-value theory, Motivation, Gender, Race/ethnicity

Introduction

Approximately one-quarter of the U.S. labor force comprises careers related to the fields of Science, Technology, Engineering, and Mathematics (STEM) (National Science Board, 2022). Considering this large and growing sector of the economy, researchers and policy-makers have devoted significant attention to motivating individuals to select STEM majors or career

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paths and retaining students as they pursue these trajectories. For example, there has been significant funding devoted to STEM education through the National Science Foundation and Institute of Education Sciences, the National Science Board submits biennial science and engineering indicators to the U.S. Congress, and there is an increasing prevalence of research publications related to STEM education (Li et al., 2020). Within this area, researchers have further worked to understand and address a persistent underrepresentation of women and Black students in STEM careers, to promote more equitable participation (National Science Board, 2022).

Yet the category of "STEM careers" is heterogeneous, with hundreds of possible career paths included, each having very different characteristics. There are *particular* labor market needs in the STEM fields of health care (e.g., physicians, nurses, home health aides), manufacturing (e.g., production assistants, welders, maintenance technicians), and computer science (e.g., application or software developers) (Association of American Medical Colleges, 2021; MacLean et al., 2014; National Association of Manufacturers, 2021; U.S. Bureau of Labor Statistics, 2015), but other STEM fields do not have career shortages (e.g., academic jobs; biomedical Ph.D.s) (U.S. Bureau of Labor Statistics, 2015). In addition, women are underrepresented in some STEM fields and associated career paths (e.g., computer science) but not others (e.g., biological sciences), and Black individuals are more heavily underrepresented compared to White individuals in some STEM fields (e.g., engineering) than others (e.g., health-care-related occupations) (Ceci et al., 2014; Cheryan et al., 2017; Ma, 2011; National Science Board, 2022; Pew Research Center, 2021; U.S. Census Bureau, 2021). Finally, careers in different STEM sub-fields are differentially associated with particular stereotypes, such as that some career opportunities will help others, require brilliance to succeed, or are gender biased (Cheryan, 2012; Ganley et al., 2018; Joshi et al., 2022; Leslie et al., 2015).

Much research exploring students' interest in STEM careers focuses on STEM as a whole. If educators, administrators, or counselors want to help students pursue STEM careers with labor market shortages, or promote equitable participation in particular careers where there are strong disparities by gender and race/ethnicity, research looking at STEM careers in general is unlikely to provide comprehensive insights about effective career education. Instead, it is important to compare students' perceptions of particular STEM careers relative to one another. The goal of the present study was to examine high school students' relative preferences for pursuing different STEM careers, the motivational beliefs underlying relative career preferences, and the role of intersecting gender and racial/ethnic identities in shaping preferences and beliefs.

STEM career choices in high school

The National Science Board (2022) defines STEM careers as careers in the fields of biological, agricultural, environmental life, computer, physical, mathematical, or social sciences, careers as engineers, or careers that require significant STEM skills and expertise in any field (e.g., health care). Individuals can pursue STEM careers without obtaining a bachelor's degree, through skilled technical positions that use STEM skills, such as those in construction, production, and maintenance. They can also pursue STEM careers by pursuing an associate's or bachelor's degree and becoming employed in a STEM or STEM-related occupation afterwards. Alternatively, some individuals pursue STEM careers by obtaining bachelor's degrees on the way to more advanced graduate studies for careers that use STEM skills and knowledge (e.g., medical school). There are thus multiple pathways that can lead to STEM career participation.

No matter which pathway students take, high school is a critical time for the development of STEM career preferences. If students are not pursuing postsecondary education, high school is the time when most will choose a career path and whether or not it will relate to the skilled technical STEM workforce. If students are pursuing postsecondary education, students' experiences prior to college provide a formative period when they solidify interests and preferences related to STEM fields that determine their major and subsequent career selection (Maltese & Tai, 2011; Sadler et al., 2012; Tai et al., 2006). During high school, students are exposed to information about potential career paths from teachers, parents, and/or the media, which shapes their beliefs about the career options available to them (see Maltese et al., 2014, for review). Students also typically decide on preliminary interests or major plans prior to enrolling in college. Understanding students' career interests in high school is essential to develop effective education and programming that encourages students to consider STEM career options.

Motivation and STEM career interest

The decision to pursue a particular career is a motivational one; students consider different career options available to them and think about which they are most motivated to pursue. This study draws from a predominant theory used to explain students' motivation for academic and career choices, Eccles and colleagues' situated expectancy-value theory of motivation (Eccles & Wigfield, 2020; Eccles-Parsons

et al., 1983). This theory posits that the two most important factors affecting an individual's motivation to do a particular achievement-related task (e.g., pursue a certain career) are the extent to which that person believes they will be competent at the task, and the extent to which they think it is valuable. Competence-related beliefs are defined in terms of individuals' self-efficacy beliefs, expectations of future success, and/or beliefs about their ability (Bong & Skaalvik, 2003; Eccles & Wigfield, 1995; Wigfield et al., 2017). Task values are defined in terms of perceptions that a task is useful (i.e., utility value), perceptions that a task is enjoyable or interesting (i.e., intrinsic value), perceptions that task success is personally meaningful or important (i.e., attainment value), and perceptions of what someone must give up to do a task such as it requiring too much time or effort (i.e., perceived cost). Attainment, intrinsic, and utility value influence task values positively, whereas perceived cost influences task values negatively. A key aspect of situated expectancy-value theory is that individuals' competence-related beliefs and task values are *situated* within particular learning contexts, which reflect individuals' unique sociocultural experiences and learning histories, are culturally bound, and are dynamic and constantly changing (Eccles & Wigfield, 2020). Thus individuals' experiences with their gender and racial/ethnic identities and their histories of interactions with socializers about particular learning tasks shape their competence-related beliefs and task values in fundamental ways.

A large body of research links students' competence-related beliefs and task values in high school to their STEM career decision-making. Much work shows that high school students' competence-related beliefs and task values for STEM classes (e.g., math, science) predict their performance in those classes and/or pursuit of STEM majors over time (Guo et al., 2016; Musu-Gillette et al., 2015; Wang, 2012; Watt et al., 2012). In addition to affecting the outcomes just noted, which are precursors of STEM career pursuit, students' perceptions of competence-related beliefs and task values in mathematics or science also *directly* predict their likelihood of entering STEM careers (Eccles & Wang, 2016; Lauermann et al., 2017; Wille et al., 2020). This body of work provides many insights about how students become motivated to study one particular STEM subject area, or how they decide to pursue STEM versus non-STEM careers. However, this research does not provide insights about students' motivational beliefs that underlie their preferences for choosing some STEM career paths relative to others. Given that contemporary writings on situated expectancy-value theory emphasize the contextualized nature of students' motivational beliefs, this question is an essential complement to existing work examining how expectancy-value motivational beliefs predict pursuing STEM versus non-STEM careers.

Comparing perceptions of different types of STEM careers

The STEM workforce is heterogeneous. Various STEM careers differ in their core topics of study and educational requirements, as well as a number of other salient features. First, some STEM careers are more common than others, so students might have much more exposure to individuals in some STEM pathways (e.g., working in health care) compared to others (e.g., working in research or data science). Students might similarly have more awareness of what careers entail in some STEM career paths compared to others. Second, as was noted earlier, STEM careers differ in their labor force representation, with some STEM career paths experiencing great shortages that need to be addressed, while other STEM career paths do not have as much need for employees (U.S. Bureau of Labor Statistics, 2015).

Third, STEM careers differ in terms of the specific stereotypes and norms around what constitutes a "typical" employee in each type of career. Some STEM sub-fields, such as the life sciences, are perceived to afford more opportunities to help or work with others (e.g., to align with communal values), compared to fields like engineering, mathematics, computer science, and chemistry, which are not perceived as strongly to afford such opportunities (Joshi et al., 2022; Su & Rounds, 2015). Some STEM sub-fields also are perceived to require more "brilliance" to succeed in them, with survey studies showing that individuals think careers in physics, engineering, mathematics, and computer science require more brilliance than do careers in biology, chemistry, neuroscience, earth science, or the social sciences (Leslie et al., 2015). Finally, individuals perceive some STEM areas to involve more discrimination and/or cultural cues that can threaten women's sense of belonging, with the areas of engineering and computer science being higher in average perceived gender discrimination and cues of belonging threat than areas of biology and social sciences (Cheryan et al., 2017; Ganley et al., 2018). To the best of our knowledge, these patterns have not been examined with respect to comparing perceived discrimination and belonging threats in different STEM fields as a function of race, but it is plausible that similar discrepancies would exist given the different levels of representation of individuals from historically marginalized racial/ethnic groups in different STEM disciplines.

All of these within-STEM differences can lead to different patterns of perceptions around particular STEM career paths, with students having interest in

some STEM careers more than others, as opposed to seeing STEM careers as a universal entity. If researchers, administrators, or policy-makers want to address shortages or labor market needs for certain STEM careers, either in a particular community or nationally, they must understand not just how students think about STEM careers versus non-STEM careers, or career interests in general, but also what motivates students to prefer some STEM careers over other STEM careers. For example, it may not be enough to provide students with an example of one particular STEM career (e.g., a role model who is a computer programmer) and assume that students are going to be motivated for STEM careers broadly as a result, or to provide information about one particular STEM career (e.g., becoming a doctor) and assume that will be sufficient for students to select that career over other STEM careers they are considering. Understanding relative beliefs about different STEM careers is particularly important for those who design or implement STEM workforce development education. Many high schools and colleges provide students with career education (e.g., counseling, web tools, career centers) related to STEM and non-STEM career options. These education efforts often consider students' motivation at a general level, for example, by giving students inventories of their vocational interests and determining which careers match them (Rottinghaus et al., 2018). However, recent discussions of STEM career education efforts have noted that career counselors or educators often have limited awareness of the broad range of potential STEM career options that exist (Rottinghaus et al., 2018). As a result, education efforts may focus primarily on screening whether students' interests align with the most "common" STEM careers as opposed to discussing the landscape of potential career options within STEM or addressing head-on how different options compare to others in STEM.

Influence of gender and race/ethnicity on STEM career preferences

It is also important to understand how experiences related to one's gender and racial/ethnic identity influence individuals' relative career preferences to ensure equitable participation in various STEM career paths. There are persistent patterns of underrepresentation in some STEM fields for women compared to men. Women earn more than half of advanced degrees in biology, chemistry, and mathematics, but they are underrepresented in many STEM career paths for which there are labor shortages, particularly in computer science and manufacturing (Cheryan et al., 2017; Deloitte, 2015; National Science Board, 2022). Cheryan et al. (2017), when reviewing the literature on women's relative underrepresentation in computer science and engineering fields, concluded that these patterns are likely a function of three factors. First, the cultures of work environments in computer science and engineering tend to lead to women experiencing a lower sense of belonging compared to the cultures of life sciences-related work environments (also see Ganley et al., 2018). Second, women may have a lack of early experience with particular fields of study such as computer science and engineering due to socialized gender norms about who should pursue different types of activities. Third, women may perceive that they are less competent in engineering and computer science related career fields compared to the life sciences. More broadly, research has shown that women prefer careers where they can help others and engage in prosocial opportunities (Diekman et al., 2010; Eccles, 1994; Shi, 2018); these opportunities are stereotypically more strongly associated with careers in the life sciences compared to physical sciences and engineering (Cheryan et al., 2017; Joshi et al., 2022). This work provides initial insights suggesting that gender preferences for STEM career paths can look very different across different STEM sub-fields. It would be useful to test these predictions directly, by comparing how students of different genders consider the relative appeal of some STEM career paths relative to others and what specific motivational beliefs underlie these relative preferences.

There are also patterns of underrepresentation in STEM fields for Black students compared to White students. Although Black students are equally likely to enroll in STEM career paths not requiring a college degree as White students, they are less likely to complete STEM career paths requiring a college degree, and they are less likely to persist in completing STEM career paths during college (Chen, 2015; National Science Board, 2022; Riegle-Crumb et al., 2019). Research points to multiple different explanations for this phenomenon, including that Black students may particularly value careers, where they can help others (and non-STEM career paths are more often stereotypically associated with affording opportunities to help others), that they might experience threats to their sense of belonging in their learning and career environments due to pervasive negative stereotypes related to race, that they might have less enjoyable experiences in STEM learning contexts compared to White students, and/or that they receive lower grades in STEM courses which can threaten their competence-related beliefs in STEM fields (Chang et al., 2014; Seals, 2016; Thoman et al., 2015; Walton & Cohen, 2007).

Adding nuance to Black students' underrepresentation in STEM careers overall, emerging research suggests

that, like with gender, there is heterogeneity in terms of the extent of Black students' underrepresentation in different STEM fields. Recent data (National Science Board, 2022) suggest that Black students are less heavily underrepresented in degrees related to computer science or biological science compared to mathematics, physical sciences, and engineering. These relative patterns of participation may lead to differences in how Black high school students think about whether particular STEM career paths relative to others are interesting, relevant, or likely to provide welcoming work environments. To date, little motivational research has attempted to explain this phenomenon. At a broad level, most research exploring motivational beliefs for STEM career pursuit has focused on White students, with less research examining heterogeneity in beliefs and preferences among Black students (Decuir-Gunby & Schutz, 2014; Usher, 2018). Understanding Black students' relative motivational beliefs for different types of STEM careers can help ensure that research-based recommendations around career education are valid for racially diverse groups of students.

In considering these issues, it is important to note that students' gender and racial/ethnic identities do not occur in a vacuum. Rather, students have *intersecting* gender and racial/ethnic identities that lead them to have unique experiences in STEM career pursuit as a function of the power dynamics at play in students' learning contexts which are related to both race and gender (Crenshaw, 1989; Hsieh et al., 2021). To understand racial and gender dynamics in terms of STEM participation most fully, research must examine the heterogeneous experiences of students who belong to different gender identities as a function of their racial identities, and vice versa (Parker et al., 2020). For example, gender differences in STEM participation or interests may be more pronounced for White students than for Black students, and examining race and gender separately cannot provide insights into these phenomena.

A major goal of STEM career education and policy efforts, particularly in communities of racially and ethnically diverse students, is to address underrepresentation in STEM career participation. Without a clear understanding of how students of diverse identities weigh different STEM careers relative to one another, or how gender and racial/ethnic identity intersect to influence students' experiences, researchers cannot truly understand diverse students' patterns of STEM career interest. Recent critical analyses of STEM career workforce education efforts have called for researchers to pay more attention to students' gender and racial/ethnic identities as they uniquely shape students' STEM career preferences and interests and influence students' relative beliefs about some career paths over others (Blustein et al., 2022; Byars-Winston, 2014; Rottinghaus et al., 2018). One goal of the present study is to shed light on precisely how students' relative STEM career interests and motivational beliefs differ as a function of their intersecting gender and racial/ethnic identities.

The present study

In the present study, we examined which STEM career paths students preferred most strongly relative to others and which motivational beliefs they reported to influence those relative career preferences. We then examined whether these trends looked similar for Black boys, Black girls, White boys, and White girls. The goal of our analyses was to understand what factors are appealing or unappealing about particular STEM career paths, to provide specific and actionable recommendations to educators, counselors, and administrators around designing effective and equitable STEM research and career education.

The study's research questions were:

1. Which specific STEM careers are most- and least-preferable within a diverse group of high school students?
2. What are the motivational reasons that students think influence their relative STEM career preferences?
3. Are there differences in any trends by students' intersecting gender and racial/ethnic identities (i.e., do trends look similar for Black boys, Black girls, White boys, and White girls)?

Methodologically, understanding students' relative motivational beliefs for STEM careers is challenging using the traditional Likert-style questionnaire measures of motivation that are typical in expectancy-value research. It would not be practical to ask students to complete multiple questionnaire items reflecting each motivational belief for many different STEM career paths; these could get repetitive and frustrating to complete. In addition, the traditional questionnaire approach does not capture the most *salient* influences on students' career preferences in students' minds, but rather it reflects all possible beliefs that students might have. In the present study, to explore motivational beliefs underlying career preferences as directly and concisely as possible, we asked students to select their most- and least-preferred careers from a list of potential options. Then, we asked students to select the reason(s) they preferred or did not prefer a particular career path from a list of options, with the options

corresponding to major expectancy-value motivational beliefs. This approach helps complement existing motivational research by exploring how students think about the relative weight of different motivational beliefs in their career decision-making within STEM fields, while also maximizing the likelihood of engaged participation across the course of the study.

Methods

Participants

Participants were 526 high school students from a public school district in the Southeastern United States, located near a major U.S. city. The students were enrolled in a variety of different career, technical, and agricultural education courses in the district; courses were held in person at the time of data collection. Participating students were interested in a variety of career paths, but preliminary data and conversations with school administrators suggested that at least half of the students in the targeted sample were interested in pursuing STEM or STEM-related career paths. Students were 57.9% girls and 38.7% boys, while 2.2% did not identify with a binary gender group and 1.1% preferred not to disclose gender. In terms of race/ethnicity, students were 63.3% Black, 28.6% White, 9.6% Hispanic or Latino/a, 1.6% Asian or Asian American, and 4.6% other ethnicities (students could select more than one race/ethnicity; percentages are out of the total number of students who selected at least one race/ethnicity). Students were 23.4% first-years, 27.7% second-years, 26.6% third-years, and 22.3% fourth-years. The average age of participants was 16.21 years, *S.D.* = 1.19. Among participants, 40.1% reported that at least one of their parents had obtained a college degree from a 4-year institution, 41.9% reported that neither parent had obtained a 4-year college degree, and 18.0% reported that they were not sure about their parents' education. Participants completed the study on a volunteer basis and were treated in accordance with APA ethical guidelines. This study was approved by the University of Georgia's Human Subjects Research Office as well as the collaborating school district's internal research office.

The 526 participants represented the final sample used in analyses. In total, we received 778 survey responses with some type of complete consent form. Two-hundred-and-two responses represented individuals who did not consent to release their data to the research team, and 23 responses represented repeat survey attempts by people who had already completed the survey (in the case of repeat surveys, we used a given participant's first complete response or, if no responses were complete, their first response to the survey). A further 27 participants' responses were eliminated because they showed evidence of not engaging with the survey (e.g., answering all the same number for every item) or due to nonsense responses written for open-ended questions. This resulted in 526 unique, consenting participants who produced high quality responses for analysis.

Procedure

As part of a broader research partnership between the first author and the school district, teachers of all career, technical, and agricultural courses in all schools in the school district were asked to spend the last 15 min of a class session giving students time to complete an online survey. Teachers could choose any class session within a 3-week period of time during March, 2022 for survey administration. The survey was delivered entirely online and took students approximately 5–25 min to complete. The survey asked students about their future career plans, then provided students with a brief definition of STEM-related careers, defined as follows: "Careers related to the fields of science, technology, engineering, and mathematics (STEM). STEM-related careers include: careers as scientists or engineers, careers in computer programming, information technology or technicians, careers in medicine or many medical fields, careers in technical fields or industry including manufacturing, and/or careers in agriculture, farming, or natural resources." The survey then asked students questions about different specific STEM careers. Students concluded by providing background information about themselves (e.g., year in school, academic background, gender, race/ethnicity).

Measures

STEM career preferences

Participating students were shown a list of 15 STEM careers and asked, "Of all the careers just listed, which would you be most interested in pursuing?" They selected their top choice. Next, they were asked, "Which of the following careers would you be least interested in pursuing?" and could again select from the list of careers. The specific list of 15 career paths in STEM was created through collaboration between the first author and administrators in the local district, and it was informed by the first authors' previous work assessing the career plans of college STEM students enrolled in 4-year universities (Rosenzweig et al., 2021a; 2021b) and the district administrators' knowledge of the local labor market. The final list included STEM careers that (a)

students often stated wanting to pursue after college (e.g., doctor, pharmacist, nurse, physician assistant, engineer, computer programmer) and/or (b) that were in demand within the STEM workforce of the local community (e.g., computer-aided design, welding, manufacturing, data science). The team took care to include on the list of careers some that required graduate degrees, some that required only bachelor's degrees, and some that required less than a bachelor's degree, to reflect the diverse options for STEM career pathways that high school students in this district typically chose to pursue. In addition, the list of careers aimed to represent the breadth of the different areas of STEM, not just one or two STEM disciplines.

This was not intended to be a complete list of STEM careers but instead to be a representative list of a variety of STEM career options relevant to students in the target population. The goal of the present study was to assess students' pre-existing beliefs and preferences for STEM careers that they might encounter or that were available in their local labor markets. As such, we did not provide students with additional information about any specific career paths before asking them to rate their career preferences.

Motivational beliefs underlying STEM career preferences

For the career students selected as being most-preferred, and again for the career selected as least-preferred, students were asked to indicate *why* they chose that particular career as their most- or least-preferred option. They could select as many reasons as applied from a list of twelve options, presented in a checklist format. This list of options was derived from expectancy-value theory and represented reasons related to **attainment/utility value** (*I think this career would help me provide for my family, I think this career would allow me to help others, I think this career would pay well, I think this career is respected and/or high status, I think I would fit in at this career*), **intrinsic value** (*I think this career sounds exciting, I am passionate about topics related to this career, I think the day-to-day life of this career would be interesting*)**, perceived cost** (*I think I could have a good work–life balance with this career, I think this career does not require a lot of time or money to pursue*), and **competence-related beliefs** (*I think I would do well at this career*). There was also an "other" option students could select if none of the response options seemed to fit their own beliefs well. The specific content of the items was developed based on interviews with college STEM students about why they pursued or changed their career plans (Rosenzweig et al., 2021a; 2021b) in combination with adapting the wording of widely used Likert-style survey instruments measuring students' expectancy-value motivational beliefs for learning in various subject areas (Eccles & Wigfield, 1995; Flake et al., 2015). Attainment and utility value were combined into one joint metric for the present study, as has been done in other prior expectancy-value research (Lauermann et al., 2017; Watt et al., 2012). Although they are distinct value components, these two concepts overlap, because one's goals are often also personally meaningful (Wigfield et al., 2017). When thinking about career pursuit in particular, students' career goals often are closely tied to students' identities and thus especially meaningful. The reasons in the attainment/utility value category in the present study were common factors articulated by students as influencing their career decision-making in prior research (Rosenzweig et al., 2021a; 2021b). Each of these reasons (e.g., this job allows me to help others) were closely tied both to one's perception of personal meaningfulness and to one's perception of what is useful for one's career goals. Thus we used a combined value measure in the present study.

Gender and race/ethnicity

Students self-reported their gender (boy, girl, non-binary, or prefer not to say) and race/ethnicity (students could select all that applied from this list: African American or Black, White, Hispanic/Latino/Latina, Asian or Asian American, Native American, Middle Eastern, or other ethnicities). We created two race/ethnicity groups for the race/ethnicity- and gender-related research question tested in the present study (Research Question 3), comparing Black students to White students, with students who exclusively identified with other racial/ethnic groups excluded from these analyses. This choice was made because White and Black students were the two largest racial/ethnic groups in the sample. We also created two gender groups, girls and boys, for Research Question 3, excluding students who identified with non-binary gender groups or who did not disclose gender from analysis of this research question. We used these classifications to create four groups who were the focus of the gender and race/ethnicity analyses: Black girls, White girls, Black boys, and White boys. Students ($n=14$) who indicated identifying with both Black and White racial/ethnic groups were classified as Black in this study, to capture as broadly as possible the experiences of any students who had a historically marginalized racial/ethnic background in STEM related to being Black.

Attrition and missing data

Students volunteered to participate without incentives in this study, and so not all students completed the entire study. Between 463 and 465 students completed the questions about career preferences, with specific response numbers depending on the specific question

of interest (this represented 88.0–88.4% of the sample). Between 459 and 462 students completed the different questions about the motivational beliefs that drove their career preferences (87.2–87.8% of the sample), and between 444 and 447 students completed the various demographic questions (84.4–84.9% of sample). Missing data were treated with listwise deletion.

Analytical strategy

To examine Research Question 1, which focused on students' interest in specific STEM careers, we used descriptive statistics to assess which careers were most frequently ranked as the most- and least-preferred options. For Research Question 2, which explored students' reasons for interest or disinterest in particular careers, we looked at which reasons were most frequently referenced across the entire sample in why students chose their most- or least-preferred careers (regardless of the specific careers chosen). For additional contextual information, we then re-ran these analyses looking separately at the most common reasons selected for each of the five careers that were ranked as most-preferred by students and each of the five that were ranked as least-preferred. These analyses used all students in the sample who completed the relevant questions.

Research Question 3 explored whether the relations in Research Questions 1–2 looked different as a function of gender and race/ethnicity. The analyses for this research question used only students who identified with Black and/or White racial/ethnic groups in some way, excluding individuals who identified solely with other racial/ethnic groups. It also excluded students who identified with gender identities that were not boys or girls. We assessed this question by conducting chi-squared tests in SPSS (version 28). We first looked at how many students chose each of the careers that students ranked as most- or least-preferred and whether this differed significantly as a function of group (i.e., Black girls, White girls, Black boys, or White boys). We only examined these trends for the top five careers listed as most- or least-preferred by students, so as to ensure adequate sample size for analyses. We used the same approach to examine how many students selected each reason for preferring or not preferring particular careers and whether that differed significantly as a function of gender x racial/ethnic group membership. Each career or reason was examined in a separate analytical model; when the overall model showed a significant chi-squared value, we prompted SPSS to provide pairwise comparisons of the four groups to determine which specific groups were significantly different from one another within the overall model. A power analysis suggested that to detect a significant difference across the intersecting racial/ethnic and gender groups for a particular selection of career or reason, in a chi-square test of independence, with effect size of $w = 0.3$ (a moderate effect), $df = 3$, $\alpha = 0.05$, and 0.80 power, the required sample size would be at least 121 participants.

For Research Question 3 analyses, there were multiple analytical models used to test each aspect of the research question. We, therefore, used a False Discovery Rate procedure (Benjamini & Hochberg, 1995) to decrease the chance of making a Type 1 error in interpreting the results of the data across these multiple models. To conduct this procedure, for each group ("family") of related significance tests, we rank-ordered the significance of each test from the lowest to highest p values (i.e., the most to least significant findings). Instead of comparing each p value to a standard threshold of $\alpha = 0.05$, we compared the significance or p value of each specific test in the "family" to a threshold computed using the formula $(i/m)^*q$. This threshold is based on the desired false discovery rate across the test family (q), the number of tests in the family (m), and the relative rank-ordering of the significance value of that particular test (i). We computed adjusted significance thresholds across each group of related tests (i.e., the group of five tests looking at group differences in selecting most-preferred careers, the group of five looking at this for least-preferred careers, the group of eleven tests looking at group differences in selecting reasons behind most-preferred careers, and the group of eleven looking at this for least-preferred careers) to determine whether overall chi-squared findings remained significant when accounting for this adjustment. We used a familywise false discovery rate of $q = 0.05$. For ease of interpretation by readers, we have adjusted all reported p values in the tables in this paper to be based on a variation of this formula, $(p^*m)/i$, which allows readers to do a direct comparison of each p value to a 0.05 threshold.

Results

STEM career preferences

Overall findings

One goal of the study was to determine which specific STEM careers were most- and least-preferred by high school students (Research Question 1). Table 1 reports the findings regarding students' reports of their most-preferred and least-preferred STEM career choices. The top-selected most-preferred careers were doctorate-level health care positions (e.g., doctor, veterinarian, pharmacist; 29.2% of students selected this category), non-doctorate-level health care positions (e.g., nurse,

Table 1 Students' rankings of most- and least-preferred stem career choices

	Most-preferred career paths		Least-preferred career paths	
Position	**Career type**	**Percent selecting (%)**	**Career type**	**Percent selecting (%)**
1	Doctorate-Level Health Care Careers	29.2	Careers in Welding, Soldering, or Machine Operation	16.2
2	Non-Doctorate-Level Health Care Careers	18.3	Doctorate-Level Health Care Careers	12.5
3	Engineer	11.2	Computer Programmer, Software Developer, or Computer Scientist	10.6
4	Computer Programmer, Software Developer, or Computer Scientist	8.8	Engineer	8.6
5	Careers in Welding, Soldering, or Machine Operation	8.8	Electrician	8.6
6	Careers in Agriculture or Natural Resources Management	4.7	Dietitian or Nutritionist	8.4
7	Electrician	3.9	Non-Doctorate-Level Health Care Careers	6.3
8	Research Scientist	2.6	Careers in Data Science	6.0
9	Careers in Public Health	2.6	Careers in Computer-Aided Design	4.8
10	Careers in Environmental Conservation	2.2	Careers in Agriculture or Natural Resources Management	3.5
11	Careers in Manufacturing	1.9	Research Scientist	3.5
12	Careers in Biotechnology or Pharmaceuticals	1.9	Careers in Manufacturing	3.2
13	Careers in Computer-Aided Design	1.9	Careers in Public Health	3.2
14	Dietitian or Nutritionist	1.5	Careers in Environmental Conservation	2.8
15	Careers in Data Science	0.4	Careers in Biotechnology or Pharmaceuticals	1.7

$n = 465$ students for most-preferred; 463 students for least-preferred

physician assistant, veterinary assistant; 18.3% of students selected this category), careers in engineering (11.2% of students selected), careers in technical skilled trades of welding/soldering/machine operation (8.8% of students selected), or careers in computer programming/computer science (8.8% of students selected). The careers that were at the bottom of the list for most-preferred careers were those in data science (0.4% of students selected this career category as the most-preferred one), careers as a dietitian/nutritionist (1.5% of students selected), careers in computer-aided design (1.9% of students selected), careers in biotechnology or pharmaceuticals (1.9% of students selected), and careers in manufacturing (1.9% of students selected).

We also asked students to select which career was least preferable to them. The top-selected least-preferred careers were not the same careers as those which were least often ranked as most-preferred. Instead, the most frequently selected careers regarding what students would least prefer to do overlapped somewhat with the careers selected as being most-preferred. These were careers in technical skilled trades of welding/soldering/machine operation (16.2% of students selected this category as the least-preferred career), health care doctorate-level careers (12.5% of students selected), careers in computer programming/computer science (10.6% of students selected), careers in engineering (8.6% of students selected), and careers as an electrician (8.6% of students selected).

Differences as a function of gender and race/ethnicity

Another study goal was to explore whether there were differences in career preferences as a function of students' intersecting racial/ethnic and gender identities (Research Question 3, Part 1). We, therefore, examined whether the proportion of students who selected each career as most- or least-preferred differed significantly as a function of students' intersecting gender and racial/ethnic identities. The overall chi-squared analyses (see Table 2) showed that there were significant differences in the proportion of students who selected careers as a function of gender and racial/ethnic group for all five most-preferred career options and three of the least-preferred career options. A visualization of significant differences can be seen in Fig. 1.

Most-preferred careers Follow-up tests to the overall chi-squared analyses suggested that there were at least some significant gender differences in the proportion of students who selected all five of the most-preferred career paths (see Fig. 1 for visualization). Specifically, girls more often selected doctorate-level and non-doctorate-level

Table 2 Gender and race/ethnicity differences in selection of most- and least-preferred careers

Most-preferred career	Black girls		White girls		Black boys		White boys		χ^2	*p*
	n	%	*n*	%	*n*	%	*n*	%		
Doctorate-Level Health Care	68	41.70	23	34.80	24	21.80	4	8.50	24.73	.001
Non-Doctorate-Level Health Care	48	29.40	15	22.70	5	4.50	1	2.10	37.18	.005
Engineer	6	3.70	5	7.60	24	21.80	7	14.90	22.19	.001
Welding/Soldering/Machine Operation	3	1.80	7	10.60	8	7.30	13	27.70	23.81	.003
Computer-Related	8	4.90	1	1.50	20	18.20	2	4.30	33.65	< .001
Least-preferred career	**Black girls**		**White girls**		**Black boys**		**White boys**		χ^2	*P*
	n	%	*n*	%	*n*	%	*n*	%		
Welding/Soldering/Machine Operation	40	24.50	10	15.20	10	9.10	4	8.50	14.24	.008
Doctorate-Level Health Care	7	4.30	3	4.50	23	20.90	12	25.50	29.75	.005
Computer-Related	20	12.30	14	21.20	6	5.50	3	6.40	11.64	.015
Engineer	22	13.50	5	7.60	8	7.30	2	4.30	5.41	.180
Electrician	9	5.50	2	3.00	9	8.20	3	6.40	2.05	.562

n = 386 students. Adjusted *p* values shown as consistent with a correction for a familywise false discovery rate of .05 (Benjamini & Hochberg, 1995). Percentages shown are the percentages of students within a particular group who chose a particular career

health care career paths as most-preferred compared to boys, with effects holding among both Black and White students. Conversely, girls less often selected careers in welding/soldering/machine operation compared to boys, again among both Black and White students. For careers in engineering and computer programming/computer science, more Black boys selected these careers as most-preferred compared to Black girls. However, there were no significant gender differences among White students.

There were also some significant racial/ethnic differences for three of the top five most-preferred career paths (see Fig. 1 for visualization). For careers in welding/soldering/machine operation, a higher proportion of White students selected the career as most-preferred compared to Black students, with effects holding among both girls and boys. For careers in computer programming/computer science and doctorate-level health care careers, a higher proportion of Black boys selected the career compared to White boys, but there were no significant racial/ethnic differences among girls.

Least-preferred careers There were fewer significant effects when looking at least-preferred career paths (see Fig. 1). Three career paths had gender differences. Consistent with what was observed for most-preferred careers, a higher proportion of boys than girls selected doctorate-level health care career paths as least-preferred, and effects held among both Black and White students. Also partially consistent with trends observed for most-preferred careers, a higher proportion of Black girls selected careers in welding, soldering, or machine operation as their least-preferred career path compared to Black boys; however, this difference was not observed among White students. Finally, for computer programming/computer science careers, a higher proportion of White girls selected this category as least-preferred compared to White boys, but there were no significant differences among Black students. There were no significant differences by race for any of the least-preferred career paths.

Motivational beliefs underlying STEM career preferences

Overall findings

The other major goal of the study was to understand the motivational reasons that students reported to influence their relative career preferences (Research Question 2). Tables 3 and 4 show the different motivational reasons students could indicate for why they selected their most- and least-preferred STEM careers, and the frequency with which students chose each of these reasons. Data are reported both overall and specifically for each of the top five choices of most- and least-preferred STEM careers. Figure 2 visualizes the most frequent *categories* of expectancy-value motivational reasons students selected as influencing their most- and least-preferred career choices, instead of individual reasons.

In terms of reasons why careers were most preferable to students, the top category of reasons for selecting a most-preferred career was that of reasons related to utility and attainment value (see Fig. 2). The top specific reasons noted were thinking a career would allow one to

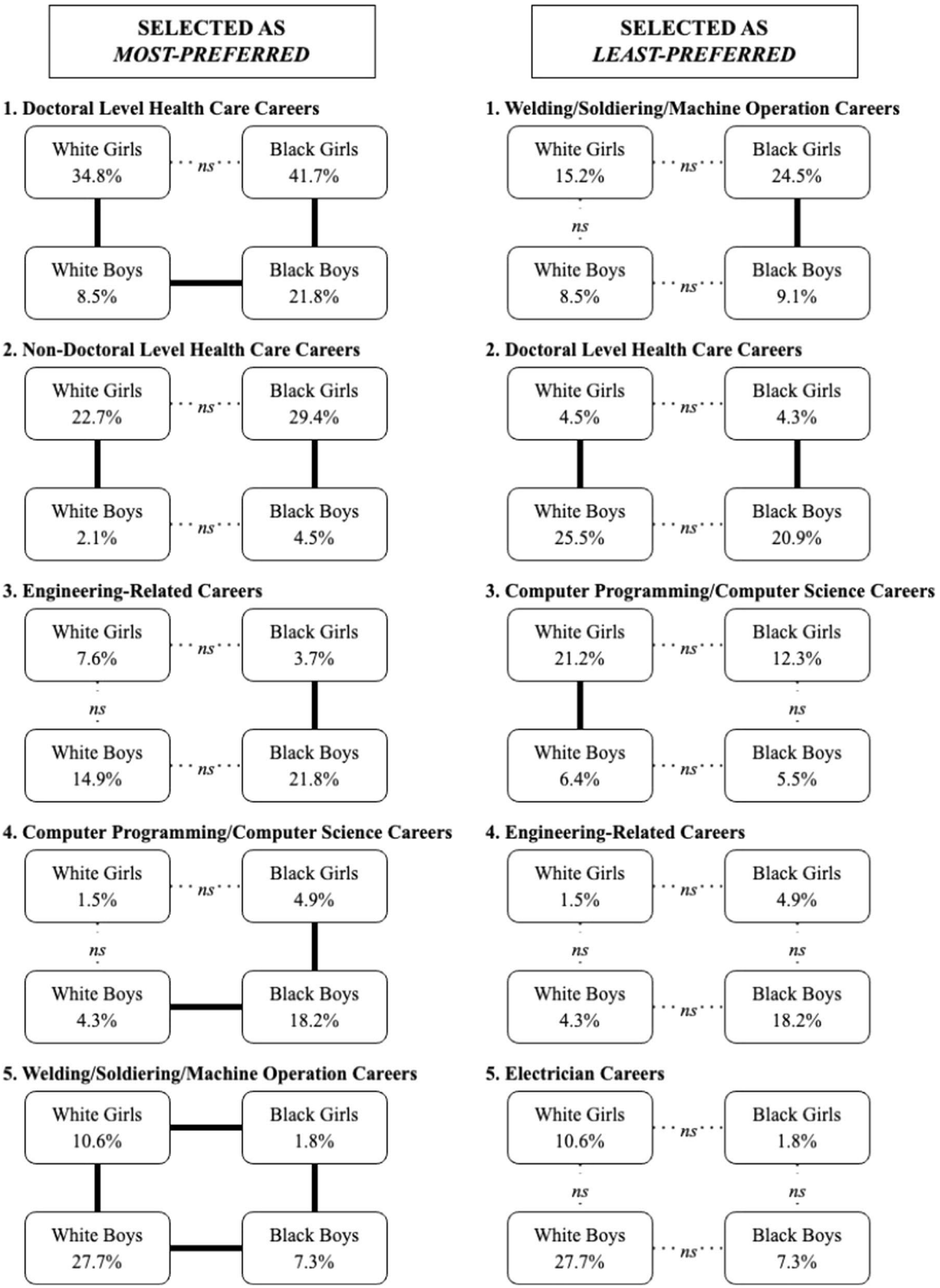

Fig. 1 Gender and racial/ethnic differences in selection of most- and least-preferred careers. Vertical lines show gender differences and horizontal lines show racial/ethnic group differences. Statistically significant differences ($p < .05$) are noted in bold lines, non-significant differences are noted with dotted lines

Table 3 Reasons for selecting most-preferred STEM career paths

Reason	Overall (n = 462)	Doc. Health Care (n = 136)	Non-Doc. Health Care (n = 84)	Engineer (n = 51)	Weld./Sold./ Mach. (n = 41)	Comp.-Related (n = 41)
Utility/Attainment Value	*n* *%*	*n* *%*	*n* *%*	*n* *%*	*n* *%*	*n* *%*
I think this career would help me provide for my family.	221 47.8%	64 47.1%	41 48.8%	28 54.9%	21 51.2%	17 41.5%
I think this career would allow me to help others.	258 55.8%	100 73.5%	67 79.8%	14 27.5%	11 26.8%	9 22.0%
I think this career would pay well.	234 50.6%	73 53.7%	46 54.8%	27 52.9%	22 53.7%	18 43.9%
I think this career is respected and/or high status.	114 24.7%	43 31.6%	27 32.1%	8 15.7%	8 19.5%	4 9.8%
I think I would fit in at this career.	235 50.9%	68 50.0%	45 53.6%	28 54.9%	21 51.2%	17 41.5%
Intrinsic Value						
I think the day-to-day life of this career would be interesting.	193 41.8%	66 48.5%	45 53.6%	15 29.4%	17 41.5%	13 31.7%
I think this career sounds exciting.	198 42.9%	56 41.2%	38 45.2%	21 41.2%	23 56.1%	18 43.9%
I am passionate about topics related to this career.	183 39.6%	66 48.5%	37 44.0%	15 29.4%	12 29.3%	14 34.1%
Competence-Related Beliefs						
I think I would do well at this career.	235 50.9%	73 53.7%	48 57.1%	24 47.1%	19 46.3%	15 36.6%
Perceived Cost						
I think I could have a good work-life balance with this career.	142 30.7%	44 32.4%	27 32.1%	16 31.4%	13 31.7%	11 26.8%
I think this career does not require a lot of time or money to pursue.	39 8.4%	9 6.6%	3 3.6%	3 5.9%	9 22.0%	3 7.3%

Note: Top 5 reasons in each column are highlighted in gray. 8 people selected "Other reasons" initially as one of their reasons. Doc. Health Care = Doctorate-level health care careers. Non-Doc. Health Care = Non-doctorate-level health care careers. Weld./Sold./Mach. = Careers in welding, soldering, or machine operation. Comp.-Related = Careers in computer science, computer programming, or software development. Percentages do not add up to 100, because students could select more than one option. Percentages shown are the percentages of students who selected a particular reason either overall (in the Overall column) or among the students who selected a particular career as most-preferred (in the other columns)

help others (related to utility/attainment value; 55.8% of students selected this option), thinking one would fit in at the career (related to utility/attainment value; 50.9% of students selected), thinking one would do well at the career (related to competence-related beliefs, 50.9% of students selected), thinking the career would pay well (related to utility/attainment value; 50.6% of students selected), and thinking the career would help provide for one's family (related to utility/attainment value; 47.8% of students selected) (see Table 3).

Many of these overall patterns held when exploring the specific STEM careers that students ranked as most-preferred, with two major exceptions. First, not all of the reasons that were most often selected overall were selected for each of the individual top five preferred STEM careers. For doctorate- and non-doctorate-level health care positions, students often selected helping others as the top reasons for choosing these career paths, but for the careers of engineering, welding/soldering/machine operation, or computer programming/computer science, providing for one's family was the reason more often selected. Second, there was a different relative ranking of reasons across the different specific careers. For health care positions, helping others was by far the most common reason selected for students preferring those careers (73.5% and 79.8% of students selected these reasons for doctorate- and non-doctorate-level careers, respectively), followed by the career paying well (53.7% and 54.8% of students selected) and doing well at the career (53.7% and 57.1% of students selected). In contrast, for welding/soldering/machine operation and computer programming/computer science careers the most frequent reasons selected for preferring that career were that the career sounded exciting (56.1% and 43.9% of students selected, respectively), the career would pay well (53.7% and 43.9% of students selected), and the career would help provide for one's family (51.2% and 41.5% of students selected) or students would fit in at the career (51.2% and 41.5% of students selected). For engineering, fitting in at the career or providing for one's family were the top reasons students selected the career as being most-preferred (54.9% of students selected each of these reasons), followed by the career paying well (52.9% of students selected).

For least-preferred careers (Table 4), there was more consistency in terms of the most common motivational

Table 4 Reasons for selecting least-preferred STEM career paths

Reason	Overall (n = 459)	Weld./Sold./ Mach. (n = 75)	Doc. Health Care (n = 55)	Comp.-Related (n = 49)	Engineer (n = 40)	Electrician (n = 40)
Utility/Attainment Value	*n* *%*	*n* *%*	*n* *%*	*n* *%*	*n* *%*	*n* *%*
I think this career would not help me provide for my family.	47 10.2%	7 9.3%	4 7.3%	1 2.0%	8 20.0%	4 10.0%
I think this career would not allow me to help others.	37 8.1%	9 12.0%	3 5.5%	1 2.0%	5 12.5%	3 7.5%
I think this career would not pay well.	35 7.6%	7 9.3%	3 5.5%	2 4.1%	1 2.5%	4 10.0%
I think this career is not respected and/or low status.	26 5.7%	6 8.0%	1 1.8%	2 4.1%	0 0.0%	4 10.0%
I do not think I would fit in at this career.	269 58.6%	54 72.0%	26 47.3%	30 61.2%	23 57.5%	27 67.5%
Intrinsic Value						
I think the day-to-day life of this career would be dull or boring.	114 24.8%	22 29.3%	12 21.8%	14 28.6%	5 12.5%	12 30.0%
I think this career sounds dull or boring.	173 37.7%	29 38.7%	20 36.4%	21 42.9%	17 42.5%	15 37.5%
I am not interested in topics related to this career.	195 42.5%	36 48.0%	20 36.4%	24 49.0%	19 47.5%	19 47.5%
Competence-Related Beliefs						
I do not think I would do well at this career.	221 48.1%	41 54.7%	28 50.9%	27 55.1%	19 47.5%	24 60.0%
Perceived Cost						
I do not think I could have a good work-life balance with this career.	56 12.2%	12 16.0%	13 23.6%	4 8.2%	7 17.5%	4 10.0%
I think this career is too expensive or time-consuming to pursue.	44 9.6%	5 6.7%	14 25.5%	4 8.2%	5 12.5%	2 5.0%

Note: Top 5 reasons in each column are highlighted in gray. 8 people selected "Other reasons" initially as one of their reasons. Doc. Health Care = Doctorate-level health care careers. Weld./Sold./Mach. = Careers in welding, soldering, or machine operation. Comp.-Related = Careers in computer science, computer programming, or software development. Percentages do not add up to 100, because students could select more than one option. Percentages shown are the percentages of students who selected a particular reason either overall (in the Overall column) or among the students who selected a particular career as least-preferred (in the other columns)

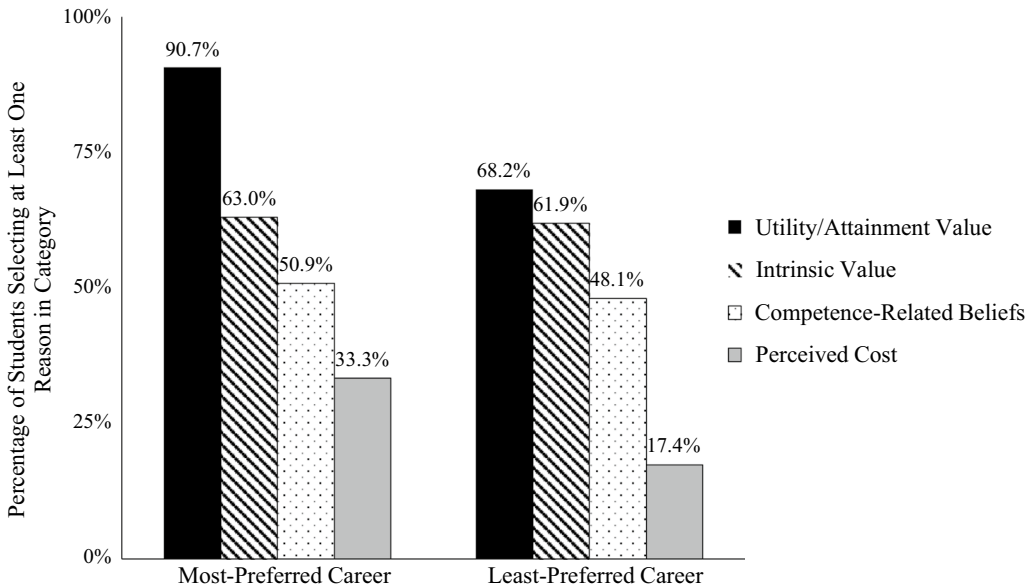

Fig. 2 Percentage of students selecting at least one option for each different category of motivational reason underlying their choice of most- and least-preferred careers. Percentages add up to more than 100, because students could select more than one option

beliefs selected to influence students' preferences. Again, the category of utility/attainment value was the most common category of reasons selected by students in affecting their least-preferred career choice, but this was closely followed by competence-related beliefs (see Fig. 2). In addition, different specific reasons were

selected within the utility/attainment value category for least-preferred careers as compared to what had been selected for most-preferred careers (see Table 4). The most common specific reason noted for choosing a career as being least-preferred across all students was not thinking one would fit in at the career (related to utility/attainment value; 58.6% of students selected this option). This was followed by not thinking one would do well at the career (related to competence-related beliefs; 48.1% of students selected), not being interested in topics related to the career (related to intrinsic value; 42.5% of students selected), thinking the career in general sounded dull or boring (related to intrinsic value; 37.7% of students selected), and thinking the day-to-day life of the career sounded dull or boring (related to intrinsic value; 24.8% of students selected).

This pattern held for students who selected welding/soldering/machine operation, computer science/computer programming, and electrician career paths. Engineering diverged slightly from this pattern, with the same top four reasons as the other careers, but the fifth-most reason was not thinking a career would provide for one's family (related to utility/attainment value; 20.0% of students selected this option) instead of reporting that the career day-to-day life seemed dull or boring. Doctorate-level health care careers also diverged from the overall trend. Students most often reported that this career was least-preferred, because they did not think they would do well (related to competence-related beliefs; 50.9% of students selected), and the fifth-most reason students selected these careers as least-preferred was that the career paths were too expensive or time-consuming (related to perceived cost; 25.5% of students selected).

Differences as a function of gender and race/ethnicity

We also looked at whether the motivational reasons reported by students differed as a function of intersecting gender and racial/ethnic identity (Research Question 3, Part 2). There were some differences in the proportions of

Table 5 Gender and race/ethnicity differences in motivational reasons for selecting most-preferred STEM career path

Reasons for selecting most-preferred career	Black girls		White girls		Black boys		White boys		χ^2	*p*
	n	%	*n*	%	*n*	%	*n*	%		
I think this career would help me provide for my family.	79	48.50	33	50.00	50	45.50	28	62.20	3.71	0.464
I think this career would allow me to help others.	107	65.60	43	65.20	43	39.10	20	44.40	23.50	0.006
I think this career would pay well.	80	49.10	40	60.60	55	50.00	26	57.80	3.28	0.429
I think this career is respected and/or high status.	45	27.60	22	33.30	23	20.90	13	28.90	3.53	0.435
I think I would fit in at this career.	81	49.70	37	56.10	55	50.00	23	51.10	0.83	0.842
I think the day-to-day life of this career would be interesting.	70	42.90	46	69.70	31	28.20	19	42.20	29.01	0.011
I think this career sounds exciting.	70	42.90	36	54.50	40	36.40	21	46.70	5.76	0.227
I am passionate about topics related to this career.	70	42.90	39	59.10	29	26.40	17	37.80	19.15	0.004
I think I would do well at this career.	83	50.90	40	60.60	46	41.80	34	75.60	16.52	0.003
I think I could have a good work–life balance with this career.	53	32.50	22	33.30	30	27.30	18	40.00	2.53	0.518
I think this career does not require a lot of time or money to pursue.	8	4.90	6	9.10	9	8.20	7	15.60	5.83	0.264
Reasons for selecting least-preferred career	**Black girls**		**White girls**		**Black boys**		**White boys**		χ^2	*P*
	n	%	*n*	%	*n*	%	*n*	%		
I think this career would not help me provide for my family.	11	6.80	6	9.10	14	12.80	4	8.70	2.84	0.573
I think this career would not allow me to help others.	11	6.80	9	13.60	8	7.30	4	8.70	3.04	0.607
I think this career would not pay well.	11	6.80	5	7.60	10	9.20	3	6.50	0.60	0.987
I think this career is not respected and/or low status.	10	6.20	2	3.00	8	7.30	3	6.50	1.41	0.859
I do not think I would fit in at this career.	93	24.30	51	77.30	58	15.20	21	45.70	13.99	0.011
I think the day-to-day life of this career would be dull or boring.	29	18.00	24	36.40	27	24.80	20	43.50	16.33	0.006
I think this career sounds dull or boring.	58	36.00	32	48.50	38	34.90	24	52.20	7.09	0.127
I am not interested in topics related to this career.	75	46.60	37	56.10	39	35.80	18	39.10	7.75	0.114
I do not think I would do well at this career.	74	46.00	43	65.20	46	42.20	21	45.70	9.61	0.061
I do not think I could have a good work–life balance with this career.	18	11.20	9	13.60	14	12.80	5	10.90	0.40	0.941
I think this career is too expensive or time-consuming to pursue.	8	5.00	3	4.50	11	10.10	12	26.10	21.56	0.011

n = 384 students for most-appealing, 382 students for least-appealing. Adjusted *p* values shown as consistent with a correction for a familywise false discovery rate of .05 (Benjamini & Hochberg, 1995). Percentages shown are the percentages of students within a particular group who chose a particular reason

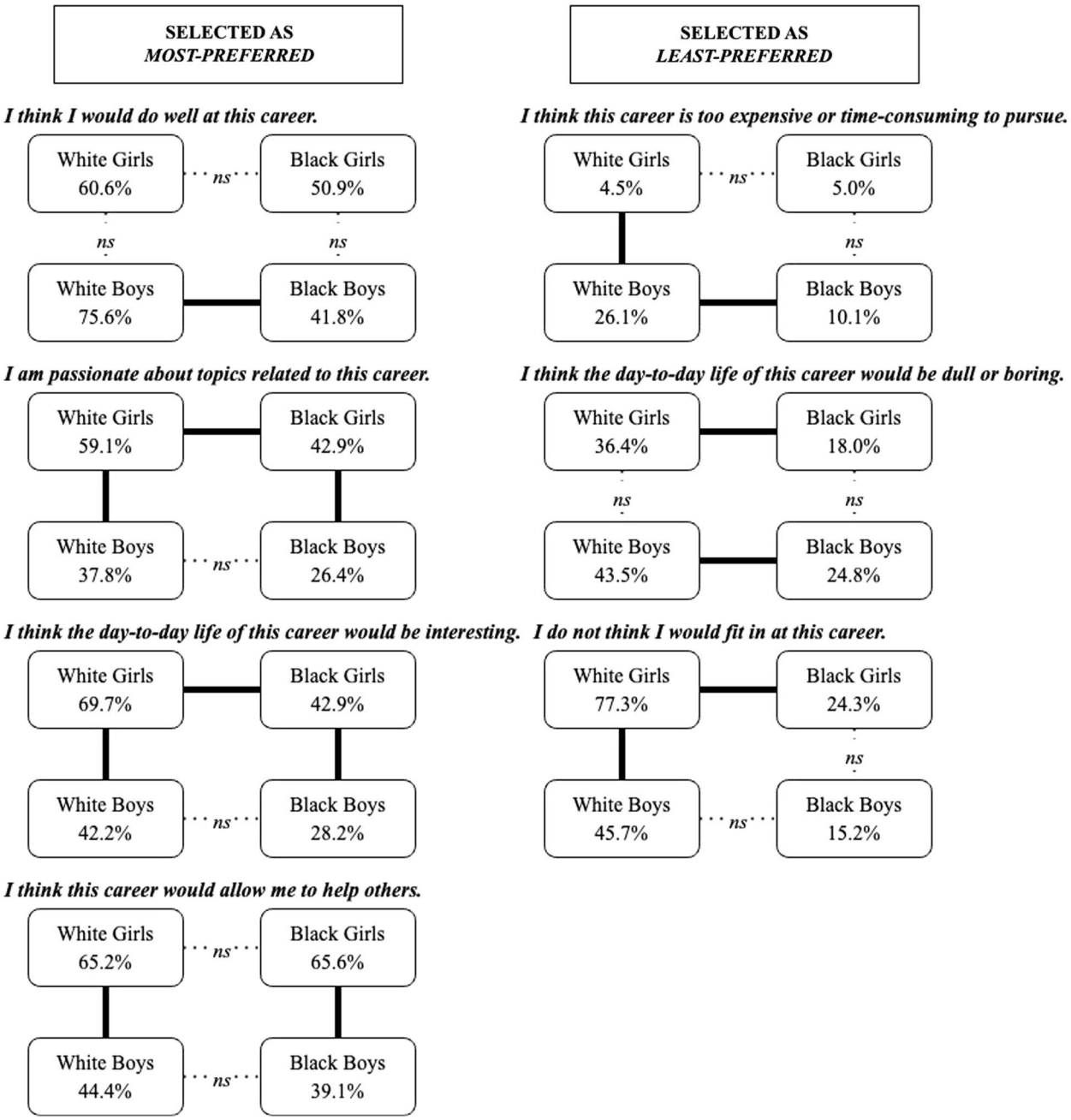

Fig. 3 Gender and racial/ethnic differences in selection of motivational reasons behind choice of most- and least-preferred careers. Vertical lines show gender differences and horizontal lines show racial/ethnic group differences. Statistically significant differences ($p < .05$) are noted in bold lines, non-significant differences are noted with dotted lines. For visual parsimony, only tests with significant omnibus chi-squared results are shown here

students who selected different motivational reasons for one's most- and least-preferred careers as a function of intersecting gender and racial/ethnic identities. Overall chi-square tests revealed significant differences for four out of eleven reasons for most-preferred careers, and three out of eleven reasons for least-preferred careers (see Table 5). Significant differences are visualized in Fig. 3.

Most-preferred careers A higher proportion of girls than boys preferred careers because they provided opportunities to help others, with significant differences

holding among both Black and White students. Relatively more girls than boys also selected their most-preferred careers because they thought the day-to-day would be interesting or they were passionate about topics related to the careers, with effects again holding among both Black and White students.

Three of the reasons out of eleven also showed some evidence of significant racial/ethnic differences, although all the effects were limited to one gender group. Specifically, a higher proportion of White girls compared to Black girls selected careers as most-preferred because they were passionate about topics related to the career or thought the career day-to-day would be interesting, but there were no significant racial/ethnic differences among boys. Conversely, a higher proportion of White boys selected a career as most-preferred because they thought they would do well at it compared to Black boys, but there were no differences among girls.

Least-preferred careers For least-preferred careers, two reasons out of eleven showed significant evidence of gender differences in follow-up tests (see Fig. 3 for visualization). A higher proportion of White girls versus White boys selected a career as least-preferred because they did not think they would fit in, but there were no significant gender differences among Black students. In addition, a higher proportion of White boys selected a career as least-preferred because they thought it was too time-consuming or expensive to pursue compared to White girls, but again these differences were not significant among Black students.

Three reasons out of eleven showed evidence of racial/ethnic differences. A higher proportion of White students compared to Black students selected a career as least-preferred because the day-to-day would be dull or boring, with effects holding among both boys and girls. A higher proportion of White girls also selected a career as least-preferred because they did not think they would fit in compared to Black girls, but effects were not significant among boys. Finally, a higher proportion of White boys versus Black boys selected a career as least-preferred because they thought it was too expensive or time-consuming to pursue, but effects were not significant among girls.

Discussion

The goal of this study was to examine high school students' perceptions of different STEM careers in order to understand why students might prefer to pursue some career STEM paths more than others. Results confirm that not all STEM career paths are equal in students' minds, with some paths being appealing, some unappealing, some polarizing, and some not very salient. In demonstrating what motivational factors might shape students' career preferences, results point to the critical role of utility and attainment value in affecting high school students' perceptions, with helping others being a major factor in determining whether careers are appealing and fitting in being a major factor in determining whether careers are unappealing. Adding nuance to these overall trends, intersecting gender and racial/ethnic differences speak to the importance of addressing cultural stereotypes around the STEM career paths that are less preferred by girls and/or Black students, to ensure that career education is equitable.

A STEM career taxonomy: appealing, unappealing, polarizing, and overlooked

Results asking students to select the most- and least-preferred STEM career options to them revealed how students perceive the relative appeal of various STEM careers. In this study, students' classifications of careers could generally be grouped into four categories, which we name appealing, unappealing, polarizing, and overlooked. One career on our list was generally *appealing* for students: non-doctorate-level health care career paths (e.g., nurse, physician assistant) were in the top five careers selected as most-preferred, and they also were *not* mentioned in the top five as least-preferred. For this career, it seems that few students reported strong negative beliefs about these careers relative to others in STEM, but many found the careers to be appealing. There was also one career that was generally *unappealing*: students rated a career as an electrician to be among the top five for least-preferred, and it was *not* in the top five for most-preferred. It seems that few students were excited about this career, but many were actively disinclined to pursue it.

Most careers did not fall into the appealing or unappealing categories. A large number of careers were noted in the top five for both most- and least-preferred careers, including doctorate-level health care careers, careers in welding/soldering/machine operation, engineering careers, and computer programming/computer science careers. These careers were *polarizing*, with many students selecting them but not all students agreeing if they had positive or negative beliefs about them. Finally, the largest group of careers were not in the top five for either list: careers as a research scientist, in public health, in environmental conservation, in manufacturing, in biotechnology or pharmaceuticals, in agriculture and natural resources management, in computer-aided design, and in data science fell in these categories. These careers were *overlooked* by students, who did not report strong positive or negative beliefs about them.

Our list provided only one snapshot of the many careers in STEM, and it should not be taken to represent all possible STEM careers available to students. For example, it is not necessarily the case that in all learning contexts, only one type of STEM career path would be considered appealing. However, we believe that the resulting taxonomy of four categories that arise from this study is useful for educators and administrators for classifying groups of STEM careers across future career learning contexts. There are two reasons why this taxonomy is useful. First, using these categories helps to illustrate the large proportion of careers that were overlooked by students. In this sample, a majority of the career options were not noted by students in a positive or negative way, and we hypothesize that this same trend would be the case in many other learning contexts as well. This is likely because students are either not aware of many specific STEM career paths relative to more well-known STEM career options, they are not sure what exactly that career would require of them, or they do not associate the career with particularly positive or negative features. Yet many of the overlooked careers were financially lucrative and in demand, both nationally and specifically in the local community from which we recruited our participants. Furthermore, not all of these careers required a college-level education, offering flexibility in future pathways for students. Instead of reflecting deeply on these careers that could align best with their values and needs, students often chose the same few well-known careers for their preferences (e.g., health care, engineering, computer science). These results suggest that students have little exposure to a large number of specific STEM career options and do not consider them as readily as they do other more well-known STEM careers. If educators and administrators want to encourage more students to pursue overlooked career paths, it is essential to provide more information about them during high school or earlier, as opposed to relying on more well-known examples like health care careers to stand in for STEM-related careers as a whole. This would require providing information about what careers are available, what those careers entail at a day-to-day level, and appealing features of these careers. Such findings echo recent calls for career educators to become more aware of the wide landscape of STEM career paths available for students (Rottinghaus et al., 2018).

A second way in which this career taxonomy is useful is to provide ideas for how specifically educators, counselors, or administrators can intervene to promote interest in different categories of STEM careers. For careers that are *overlooked*, as was just noted the main way educators can foster interest in these careers is to provide more career information about these pathways to students as opposed to more common pathways. For careers that are *appealing*, students already know of these careers and have positive beliefs about them in general, so at this point educators may want to help students make personal connections to the careers and identify with them more deeply. This can further develop their interest in pursuing these pathways relative to others, which is known to promote career engagement (Hidi & Renninger, 2006; Maltese et al., 2014; Rosenzweig et al., 2021a, 2021b). To deepen students' identification and interest with career paths, students could be asked to engage in personal reflections about the relevance of these career pathways for their future goals (Brown et al., 2015; Hulleman & Harackiewicz, 2009; Shin et al., 2019), or students could receive opportunities to identify personally with individuals in those careers through interviews or job shadowing (Casad et al., 2018; Dubetz & Wilson, 2013; Evans & Whigham, 1995). In contrast, for careers that are *unappealing* or *polarizing*, students seem to be aware of these careers, but many students (or even the majority of students) have negative perceptions that prevent them from thinking positively about the careers relative to other potential future options. In these cases, educators, counselors, or administrators could address students' negative beliefs about the careers head-on to help students think of these careers as possibilities, before or concurrently with helping individuals think about positive aspects of those careers. We discuss what specific negative beliefs seem to most strongly motivate students away from particular careers, and associated ideas for intervening to address these beliefs, in the next section.

In general, results of the present study suggest that all STEM careers should not be considered to be equivalent. Instead, it is important to understand whether students have generally positive, negative, polarizing, or no strong beliefs about particular careers and tailor career intervention efforts accordingly.

Examining motivational beliefs that underlie relative STEM career preferences

Results exploring why students chose particular careers as their most- or least-preferred options can provide specific ideas about how educators, counselors, and administrators might help students engage with particular STEM career paths more readily. Findings from the present study also are among the first to examine what motivational beliefs students perceive as most *salient* in attracting them towards particular STEM careers or making other STEM careers seem unappealing, given that most research on STEM career motivation explores how the strength of different types of motivational beliefs predict STEM career pursuit.

With respect to the motivational beliefs underlying students' *most-preferred* STEM careers, in this sample students most frequently selected attainment- and utility-value-related reasons, particularly those related to thinking about the career's pay and whether it afforded opportunities to support others (either helping others or supporting one's family). Reasons related to intrinsic value, such as thinking a career was exciting or interesting, were also attractive features noted by students. Perceptions that one would do well in a career were among the top five reasons for a career being appealing across all career choices, but on average they were not as prevalent as the attainment/utility value-related category or the intrinsic value category (when collapsing across all possible reasons in this category). Perceived cost-related reasons were not as frequently referenced as the most salient influences on students' preferences, although many students still noted these reasons as affecting them.

Educators, counselors, or administrators can use this information to tailor career supports to students more effectively. For careers that seem to be generally appealing to students, it is important to emphasize the relative utility value and attainment value of those careers, and career educators also might highlight the interesting aspects of them. These techniques can help students understand which of multiple appealing careers is most aligned with their identities and future goals and thus most-preferred to pursue. The techniques noted in the previous section for helping students deepen their identification with and interest in appealing careers (e.g., helping students to make relevance connections between career paths and their lives or future goals, job shadowing, internships) are also known to foster students' beliefs that those areas are valuable (Gaspard et al., 2015; Hulleman et al., 2010; Linnenbrink-Garcia et al., 2018; Shin et al., 2019). Thus these techniques can serve a dual purpose of helping students deepen their interest development for careers and emphasizing the useful features of different appealing careers to help more undecided students see their appeal. There are also a number of intervention techniques in the literature that are designed to help students perceive that particular career paths help others and serve communal goals (see Boucher et al., 2017, for review). These were two predominant reasons selected by students in this study, and such techniques could be useful ways to emphasize further the utility and attainment value of particular career paths. All of the techniques just discussed can be implemented or emphasized as part of students' coursework, in one-on-one conversations with students, or as extracurricular career development activities.

In examining students' reasons for why they found careers to be *least-preferred*, concerns related to fitting in were the number one factor students noted for why almost all of the top five least-preferred careers were chosen. This reason was attainment/utility value-related, but it was a different facet than was selected most often for most-preferred careers. This reason was followed by perceptions that one would not do well in a career, which are related to students' competence-related beliefs, and then reasons related to perceptions of a lack of interest in the career. When considering what career options students *do not prefer* to pursue, students seem to strongly consider whether career environments might not make them feel as though they fit in, or whether they are not able to do well at the careers.

Existing literature on STEM career selection points to the critical role of interest and fit, as well as other types of perceived task values, in shaping students' perceptions of what majors or careers they would like to pursue (Maltese et al., 2014; Perez et al., 2019; Renninger et al., 2017). The findings of this study extend prior research to examine which task value aspects are relatively more important to students in decision making, and results suggest that high school students at times think about the utility and attainment aspects of value for careers as strongly or more strongly than they do the intrinsic value aspects of career selection. These findings also show that students consider task value, including intrinsic value, as a salient factor in deciding which careers are relatively more unappealing and which are relatively more appealing. To understand how students navigate the landscape of possible STEM career options, it is critical to think about the beliefs that drive students away from certain career paths relative to others.

These findings again have specific implications for designing effective career education. For STEM careers that are either polarizing or unappealing to students, educators should address head-on students' concerns about fitting in and belonging or doing well in career paths to make these paths seem feasible. Research on fostering belonging in educational settings suggests that supporting interpersonal relationships, promoting positive mental health behaviors, and addressing socially inequitable policies and practices are useful techniques to help students feel a sense of belonging (Allen et al., 2018; Anderman, 2003; Gray et al., 2018; Wentzel, 1999). Educators and counselors might address how careers offer interpersonal connections, associate with positive emotional experiences, or are addressing workplace inequities. Educators might also reframe potential challenges and emphasize personal effort and mastery to help address belonging concerns around future careers (Allen et al., 2018; Master & Meltzhoff, 2020; Walton

& Brady, 2020). Additional ideas to address belonging concerns include making sure that students see examples of how people like them pursue these careers (e.g., through the use of role models, Gladstone & Cimpian, 2021). Research on promoting students' competence-related beliefs for STEM learning often points to helping students have success experiences and helping students vicariously learn about paths to success as key techniques (Bandura, 1997; Butz & Usher, 2015; see Rosenzweig et al., 2022 for review). Breaking down how success in particular careers can be attained step-by-step (e.g., through checklists of career benchmarks), or arranging interviews with others who have succeeded in particular careers from similar backgrounds, can help with ensuring that students feel more capable to succeed in particular career paths. These techniques, can be implemented via similar avenues as more positive value-fostering techniques.

There were more similarities than differences in how students reflected on the reasons why they most- or least-preferred certain careers, but the same motivational factors were not equally common for all career paths. For example, for the most-preferred career paths, helping others was ranked as being more important in health-care positions, while supporting one's family was ranked as more important in the engineering, welding/soldering/machine operation, and computer science positions. Results speak to the importance of educators focusing on *particular* STEM careers, how students tend to perceive them on average, and what beliefs are most salient in affecting perceptions of those careers compared to others, as opposed to treating all STEM careers as interchangeable in career education. If career educators are working with students in small-group or one-on-one settings, they might use these particular trends to tailor specific motivational efforts based on the careers students are most strongly considering.

In addition to having implications for career education, the findings of this study have implications for research that is grounded in SEVT. First, these findings shed light on an important way that students' motivational beliefs are situated, by exploring relative beliefs for various careers that are nested within the broad category of STEM. Findings emphasize the importance of moving beyond broad subject-matter classifications to address how students think about particular career paths *compared to one another*, as opposed to thinking about beliefs about one particular STEM career or the field of STEM overall. Second, this study examined situated beliefs using a checklist approach to capture the most salient motivational beliefs students thought about in determining relative career preferences. Results illustrated that some motivational ideas were more salient for students in making particular kinds of decisions (i.e., different aspects of utility and attainment value were more salient influences on most-preferred careers versus least-preferred careers). This finding demonstrates the importance of thinking about how students weigh different beliefs in their minds when making career decisions as opposed to thinking about the role of these beliefs solely using traditional questionnaire measures. Third, results of this study point to the critical importance of feeling like one fits in for career preferences, especially in terms of thinking of careers that someone would not want to pursue. Typically, items assessing attainment value in situated expectancy-value theory questionnaires relate to broad perceptions of importance or meaningfulness of certain learning tasks, not to one's perception of identity and whether it fits into particular learning environments. The salience of this item in our results suggest that researchers should consider the idea of "fitting in" more readily in thinking about expectancy-value motivational beliefs.

The intersecting role of gender and race/ethnicity in shaping STEM career perceptions

Recent reviews have called for career educators to pay much more attention to students' gender and racial/ethnic identities as they shape STEM career interests (Blustein et al., 2022). The present study contributes to this goal by exploring how students' intersecting gender and racial/ethnic identities differentiate their career preferences and motivational beliefs, with unique implications for career education and STEM workforce development research.

Gender differences

There were systematic gender differences in selection of as most- and least-preferred careers, with relatively more girls preferring health care careers and more boys preferring careers in computer programming/computer science, engineering, and welding, soldering, or machine operation. In examining the intersection of gender and race/ethnicity, not all of the specific gender effects were significantly different among both Black and White students, but for almost every career path there was *at least one* significant difference found between boys and girls in both Black and White racial/ethnic groups (i.e., there was a difference observed either in most-preferred career selection, least-preferred, or both). This speaks to the robustness of the observed gender associations across racial and ethnic groups. The only career paths for which this was not true were

engineering, where gender differences were limited to Black students and not White students, and as an electrician, where there were no significant gender differences. The observed gendered patterns in career preferences are largely consistent with existing data suggesting that nationally, girls are more heavily underrepresented in career paths related to physical science, computer science, and engineering compared to the life sciences (National Science Board, 2022). Our findings support this trend, and they also support prior work focused on STEM career interests to show that gendered differences in STEM career preferences begin well before college (Master et al., 2021).

Gender differences in students' endorsement of different motivational reasons for preferring or not preferring particular careers help explain the patterns that emerged. A significantly larger proportion of girls compared to boys selected motivational reasons related to helping others, with effects being significant among both Black and White students. This finding is consistent with prior literature showing that women tend to more strongly prefer career paths that afford prosocial opportunities (Diekman et al., 2010; Eccles, 1994; Shi, 2018). As was noted in the Introduction, students do not perceive all STEM careers to be equally likely to afford prosocial opportunities, with life sciences fields and/or careers tending to be perceived more positively in this regard than physical sciences and computer science (Cheryan et al., 2017; Ganley et al., 2018; Joshi et al., 2022). These trends could explain girls' stronger preferences towards health care careers as opposed to other career paths, with results of the present study again extending findings to high school aged students. It may be important to emphasize the prosocial appeal of other types of STEM career paths, or challenge stereotypes that certain fields do not afford prosocial opportunities, to ensure that girls remain interested in a broad variety of STEM occupations including computer science.

A larger proportion of girls versus boys also referenced choosing careers as most-preferred because of reasons relating to feeling passionate about topics related to the career. This was a novel finding, as prior literature generally has not examined students' relative consideration of interest compared to other beliefs in affecting within-STEM career choices. Career interests, as stable individual interests, are closely tied to individuals' perceptions of identity (Hidi & Renninger, 2006). Identity may be particularly salient to women in STEM, because certain STEM work environments can more strongly communicate masculine norms or make women feel as though their identities are not valued (Dasgupta & Stout, 2014; Hall et al., 2018, 2019). For example, cross-cultural research suggests that in developed countries, where women are encouraged to make choices that are consistent with their identities, there can be starker differences in whether or not women go into STEM fields (Stoet & Geary, 2018; Yalcinkaya & Adams, 2020). Heightened identity-related concerns among women in STEM may have overlapped with whether women were able to think about certain career paths as interesting or exciting for them in the present study. This may underlie the patterns of career participation that were observed, because as was noted in the Introduction these masculine norms are communicated more strongly in fields like computer science and engineering compared to the life sciences (see Cheryan et al., 2017, for review). It may be particularly necessary to address head-on girls' concerns about belonging in particular STEM career paths, to help more girls consider STEM careers that they chose as unappealing.

There were also some gender differences that were limited to White students, with relatively more White girls selecting a least-preferred career because they would not fit in at it compared to White boys, and more White boys selecting a least-preferred career because it was too expensive or time-consuming compared to White girls. The finding about fitting in is consistent with the argument just discussed that girls may have heightened identity-related concerns that shape their career decision-making compared to boys. The finding about a career's expense and time is also consistent with prior research suggests that men tend to endorse stronger career motives around making money relative to women (Zafar, 2013). The health care careers measured in our study were mostly associated with requirements for advanced degrees, so boys may have been more inclined towards careers with immediate potential for employment post-high-school or post-college. Our findings extend prior work to show that these concerns affect students as young as high school. These findings also extend prior work to suggest that in some contexts, these motives for career decision-making may be more strongly endorsed among White students than Black students. It is possible that Black students experience different types of career motives that need to be studied further, which we discuss in the next section.

Racial/ethnic differences

There were few racial/ethnic differences in career preferences that extended across both genders, with the only difference being White students' relative preference for welding-related careers. In gender-specific findings, Black boys preferred careers as doctorate-level health care workers and in computer science/computer programming more than White boys. The observed racial/ethnic differences in health care and computer

science among boys align in general with recent national data suggesting that within different types of STEM career paths, Black individuals are more strongly represented in computer science and life sciences fields relative to mathematics, physical sciences, and engineering (National Science Board, 2022). Our findings extend such conclusions to show that racial career preferences can occur as early as high school, and to show that there may be race-related differences in preferences for manufacturing-type careers (e.g., welding) versus other types of STEM career paths. Such findings point to the importance of broadening understandings of STEM and STEM-related careers to include the skilled technical workforce during high school career education, given that there were clear differences in preferences for welding/soldering/machine operation careers by race that emerged in high school (i.e., fewer Black students preferred this career than White students).

In explaining the observed patterns of racial/ethnic differences in career preferences, it is somewhat difficult, because there were few motivational reasons that aligned with the direction of the observed racial/ethnic differences in career preferences. The major consistent finding regarding race was that a larger proportion of White students compared to Black students of both genders selected a career as least-preferred, because the career's day-to-day life would be dull or boring, and a larger proportion of White girls compared to Black girls selected a career as most-preferred because of other interest-related reasons. Additional findings showed a variety of ways that relatively more White students selected particular career motives compared to Black students: relatively more White boys than Black boys selected reasons related to the expense or time required by a particular career, and selected a career as most-preferred because they thought they would do well at it. In addition, a larger proportion of White girls compared to Black girls selected careers as least-preferred because they did not think they would fit in at the career.

At a broad level, these data converge to suggest that White students selected a broader variety of reasons for their career preferences compared to Black students. Such trends may suggest that reasons related to helping others, providing for others, and good pay were the *primary* features influencing Black students' choice of career pursuits. In contrast, for White students a wider variety of factors including interest may have come into consideration. These findings are potentially consistent with research suggesting that Black students may have less enjoyable experiences in particular career paths or educational environments overall compared to White students, because Black students may have more experiences that threaten their sense of belonging due to persistent negative stereotypes (Seals, 2016); this could lead to interest being less of a factor weighed in career decision-making among Black students. We believe that at a preliminary level these findings suggest that emphasizing certain aspects of utility and attainment value such as the ability to help others and work with others, and pay for a career, are likely to be particularly powerful techniques for providing STEM career education to Black students, relative to emphasizing interest in career paths. However, these are the first findings to the best of our knowledge that have explored how students weigh their relative motivational beliefs for some STEM careers over others, and prior research in general has been limited in exploring racial differences or patterns in students' motivational beliefs (Decuir-Gunby & Schutz, 2014; Usher, 2018). It is possible that other experiences and motives influence Black students' career interests more readily than utility and attainment value but were not examined in the present study, so more research is needed to examine this phenomenon more fully. Our findings emphasize the importance of centering Black students' voices and experiences in career education research to capture most accurately the factors that affect their decision-making.

The findings around gender and racial/ethnic differences clearly emphasize the importance of addressing within-STEM heterogeneity regarding different careers, and potential gender or racial/ethnic differences in these heterogeneous beliefs, to promote equitable participation in STEM fields. Even if educators emphasize value of STEM careers broadly or provide STEM career programming in classes, this is unlikely to address gender or racial/ethnic differences in STEM career pursuit. In fact, these "global" educational techniques might risk perpetuating existing stereotypes and negative perceptions students already have about particular STEM sub-fields or career paths which are tied to their gender and racial/ethnic identities. Instead, educators must address head-on how students perceive the work environments, affordances for prosocial learning opportunities, chances to make money, and opportunities to connect topics to one's valued interests and identities in some STEM fields versus others. Within these efforts to consider STEM careers relative to others, career educators should consider the relative weight that students of different groups place on different motivational beliefs for affecting their career decision-making and tailor interventions that focus on diverse student groups accordingly. This could be done in one-on-one career counseling that takes into account students' diverse backgrounds and experiences (Blustein

et al., 2022) or educators could account for likely biases and differential perceptions in designing programming that targets students from particular combinations of gender and racial–ethnic backgrounds (e.g., if a career counselor is designing programming for a group of mostly Black girls, they might talk more about students' utility/attainment value, particularly helping others and fitting in, compared to talking about interesting features of careers).

Limitations

Although we believe that this study provides novel insights around how students weigh different types of STEM careers, there are important limitations that should be addressed in follow-up research. First, our measures of motivational beliefs were yes/no checklist-type items. We believe that this approach offers unique insights that are informative for understanding situated expectancy-value motivation, but incorporating more sensitive measures (e.g., Likert-style items reflecting each different motivational belief) would provide important additional explorations of students' beliefs about different career plans within STEM. A more detailed measurement approach would also be informative in being able to distinguish which specific motivational items most strongly reflected different SEVT constructs.

In addition, our checklist measures only captured a limited number of dimensions of the motivational beliefs that students might consider in weighing career selections. Our measures focused only on the most common experiences reported in open-ended responses from students around their career planning, using an expectancy value lens (Rosenzweig et al., 2021a, 2021b). Adding additional dimensions to the assessment of each expectancy-value motivational belief would add more exploratory power to the measure of career beliefs. For example, our measure of cost in the checklist was limited to opportunity cost and effort cost, but it would be important to capture dimensions of cost related to negative anticipated emotions or perceived discrimination in particular career paths. It would also be useful to explore other motivational beliefs that might impact students' career decision-making, such as their perceptions of autonomy that would be afforded by particular career paths (Ryan & Deci, 2020), or perceptions of race-focused constructs that might uniquely affect Black students' motivational beliefs (Decuir-Gunby & Schutz, 2014).

Another limitation is that this analysis did not account for students' own career plans. Our goal was to capture STEM career preferences in all high school students, not just those who were already interested in STEM careers. However, accounting for students' own career plans in analyses could help contextualize key findings and shed light on whether students who already have some STEM proclivities have different relative beliefs than those who do not. Similarly, we measured career preferences based on students' pre-existing awareness and knowledge of different career paths, without defining the exact career paths to them. This was done to understand how students' awareness of career options played into their preferences, but results should not be interpreted to assume that students knew about what every career path in our list required or was typically like. Future studies might examine how students respond to similar questions provided that they are knowledgeable about every career on the list.

Finally, motivational beliefs are heavily influenced by the cultural and geographical contexts in which students learn (Eccles & Wigfield, 2020). Students' relative preferences for particular STEM career paths, and associated motivational beliefs, are affected deeply by their geographical location, their cultural and community norms, and their exposure to different models pursuing particular types of STEM career paths. Future research should examine these potential influences on motivational beliefs more directly to gain a more complete understanding of what types of contextual differences most strongly influence students' relative motivational beliefs for some STEM career paths compared to others.

Conclusion

Not all STEM fields are equal in students' minds, and results of this study demonstrate how students make sense of different career options within this broad economic sector. Findings speak to the importance of moving beyond general career education that discusses the day-to-day life of various well-known career paths (e.g., doctors, engineers) as a path to boost general interest in STEM. Instead, educators should consider a few additional activities to help students consider the appeal of a broader variety of STEM careers. First, they should provide opportunities for students to reflect on the utility, attainment, and intrinsic value of STEM careers that are already appealing to them. Second, they should work to ensure that students perceive that they will belong in and succeed at careers that do not seem appealing. Third, they could provide information about a wider variety of careers, particularly those where there are local opportunities or strong labor market needs, because students are not aware of many possible career options. Finally, they can look for opportunities to tailor specific career conversations to address likely differences in attitudes as a function of students' gender and racial/

ethnic identity, with particular focus on prosocial opportunities in STEM careers and likelihood of fitting in or belonging at them, to promote equity in STEM career pursuit. These techniques can help provide more specific and actionable career supports that may boost interest in particular STEM careers, where there is a desire to boost participation.

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Author contributions
EQR led the project conceptualization, methodology, investigation/data collection, data curation, data analysis, data presentation, project supervision and administration, with assistance from X-YC on all project components. EQR engaged in the original draft writing and X-YC assisted in reviewing and editing of the manuscript. X-YC created the data visualizations. Both authors read and approved the final manuscript.

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Declarations

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